

Overview of LHDAC at Calipso Review 2006

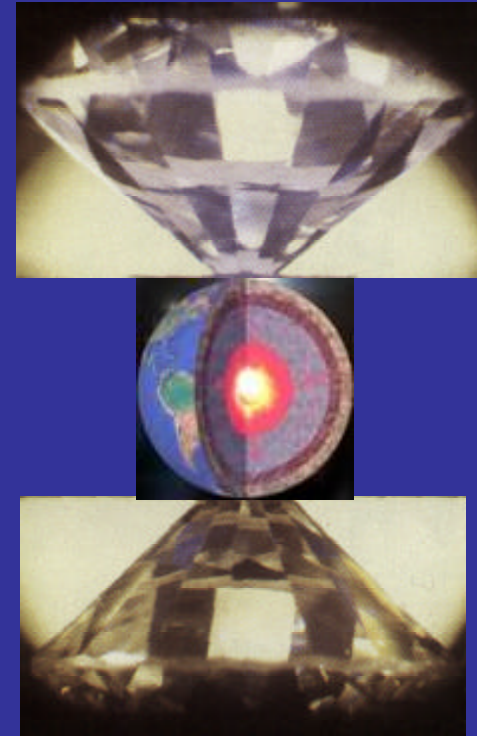
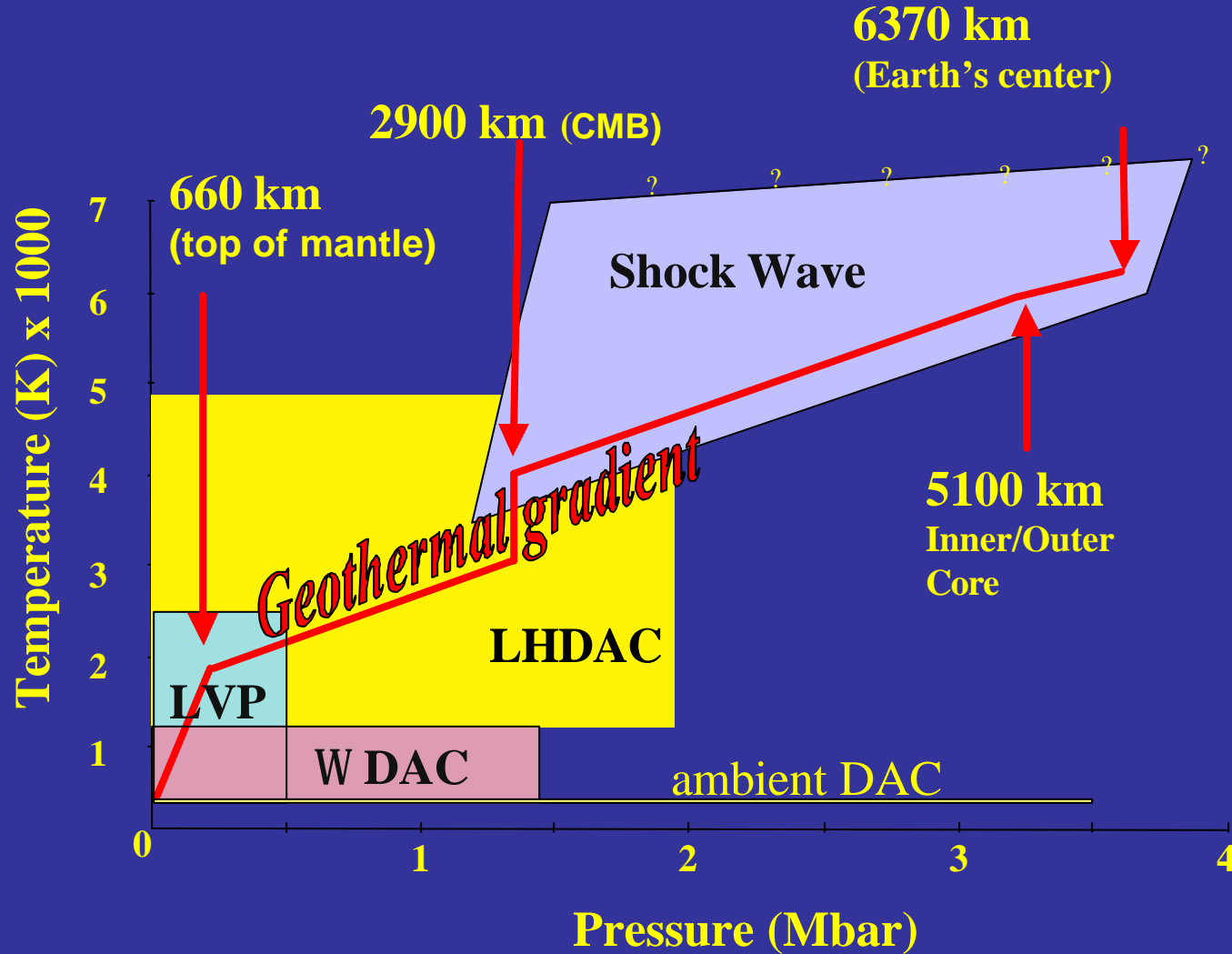
- *Introduction
- *Laser Heating Optics and Hardware
 - *Advanced Light Bulb
 - *Temperature Calibration
 - *Chromatic Aberration
 - *Temperature Gradients
- *Temperature Analysis Software
- *Radial Diffraction, FeS Liquid EOS
- *Temperature Stabilization (future)
- *Acknowledgements



California High-Pressure Science Observatory

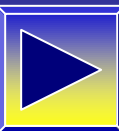
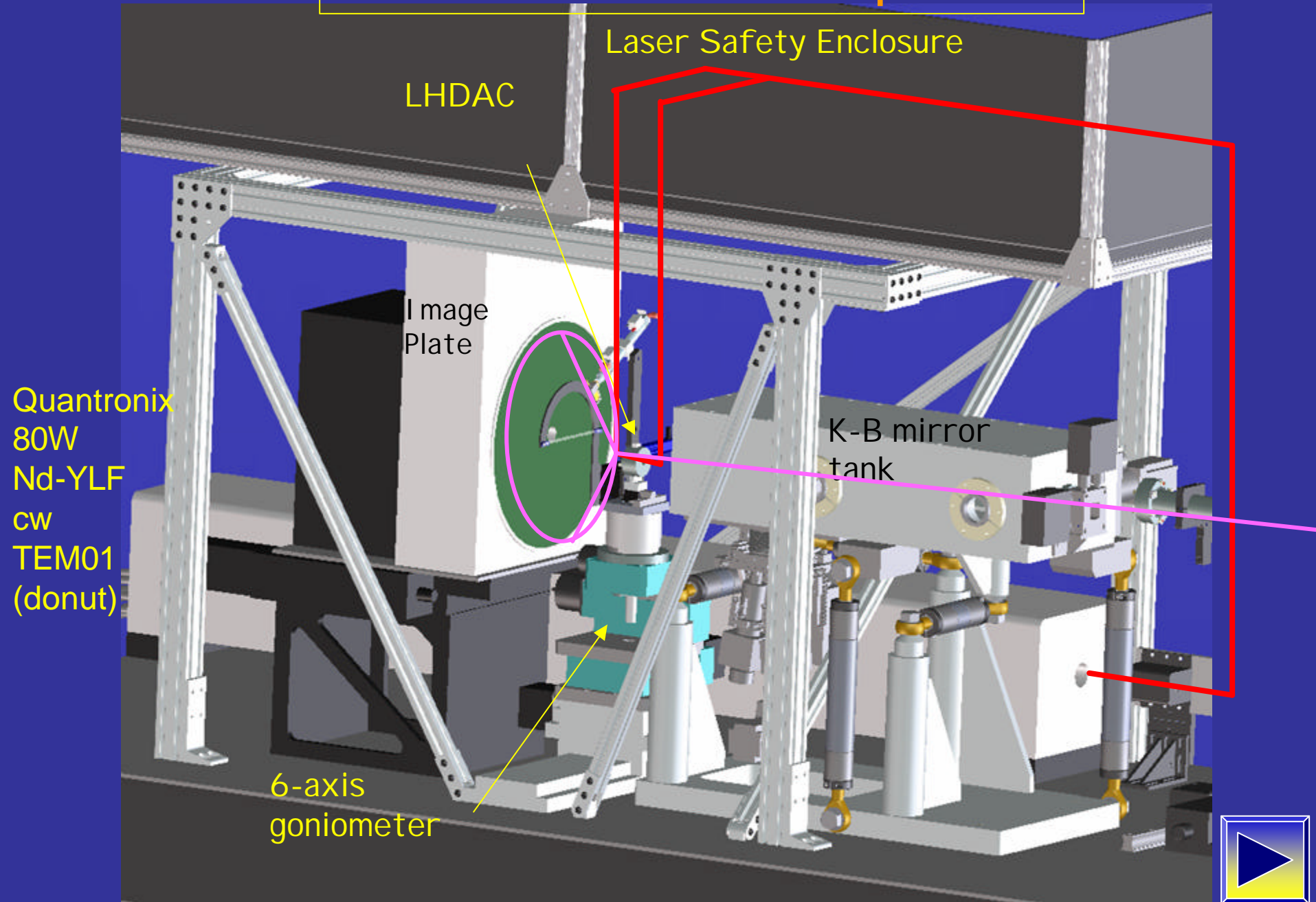


Motivation—Study of Earth's Deep Interior

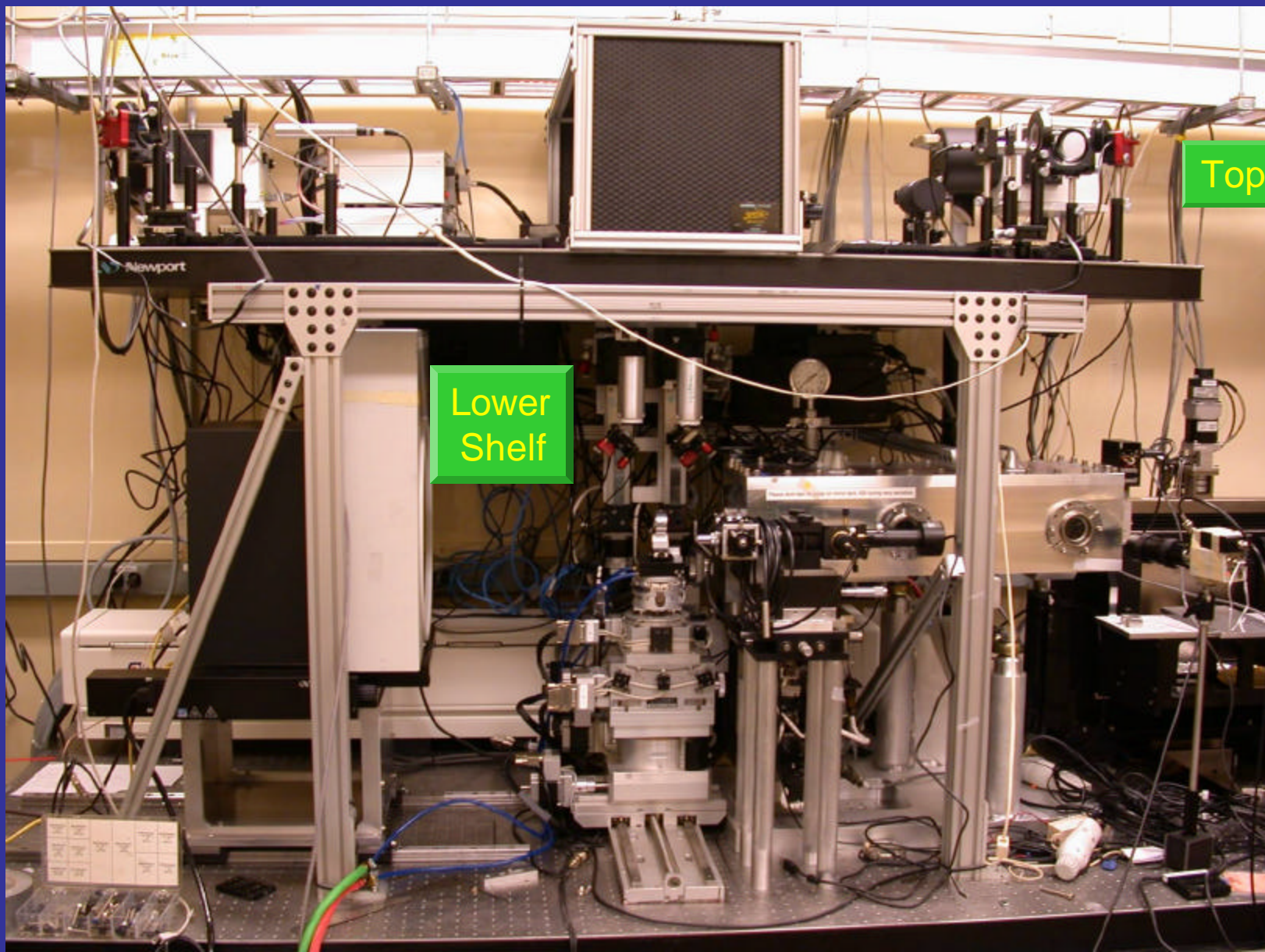


Secondary motivation: 1) novel materials synthesis (pressure cooking)
2) exploring P-T plane (thermodynamics, ϕ diagrams)

LHDAC at the ALS - present



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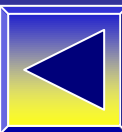
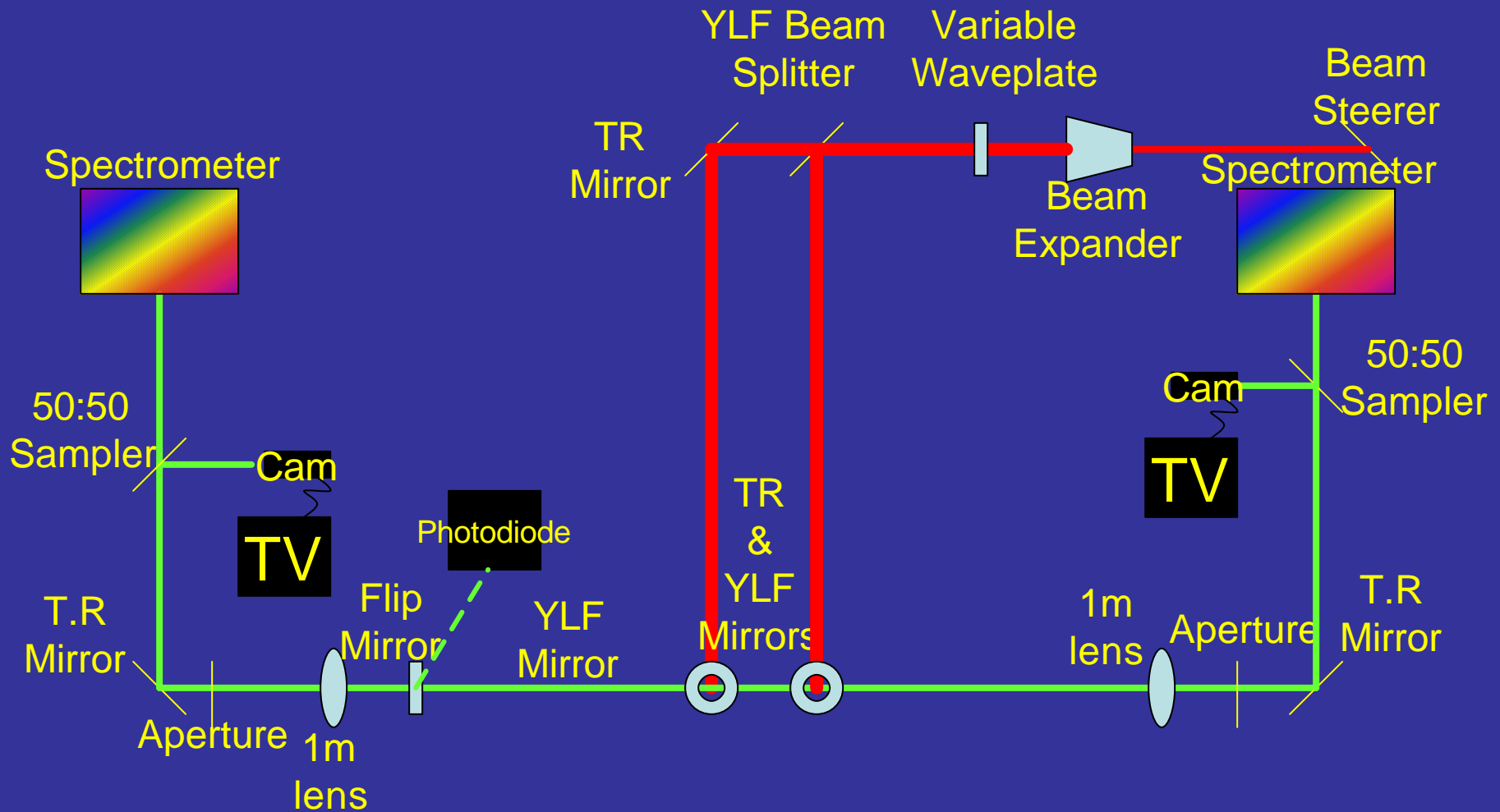
Top Shelf

Lower
Shelf

Laser Heating Optics and Hardware

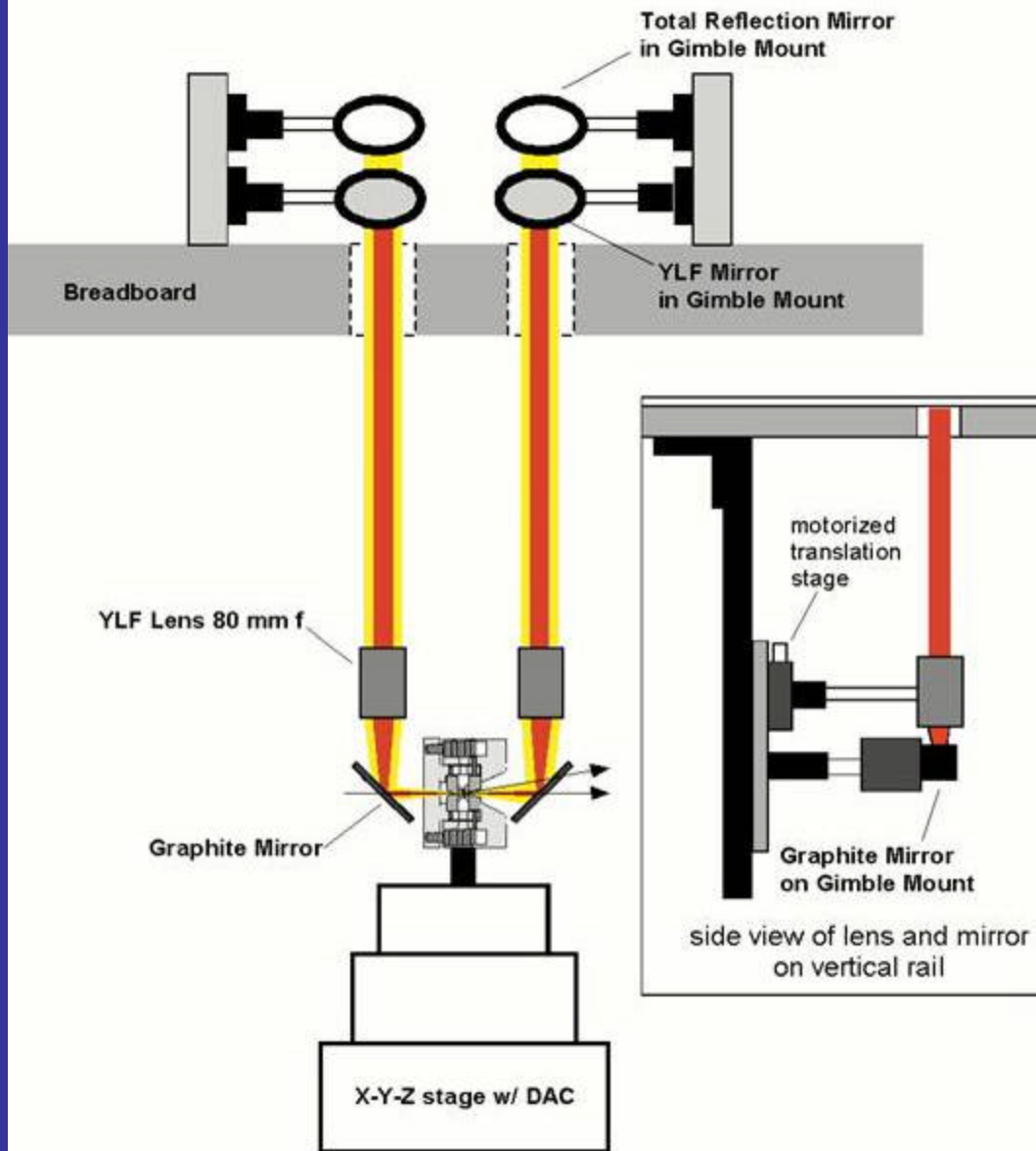
- New laser power supply and control unit (old repaired units to be used as 2nd string backups)
Increased reliability
- Optics at prescribed positions, better imaging
- Beam expander—control divergence, better focusing
- Lower shelf (objective) optics on motorized rails (~1 micron precision) Easier to switch from laser heating to ambient temperature diffraction

Sketch of Laser Heating System in 12.2.2 Hutch

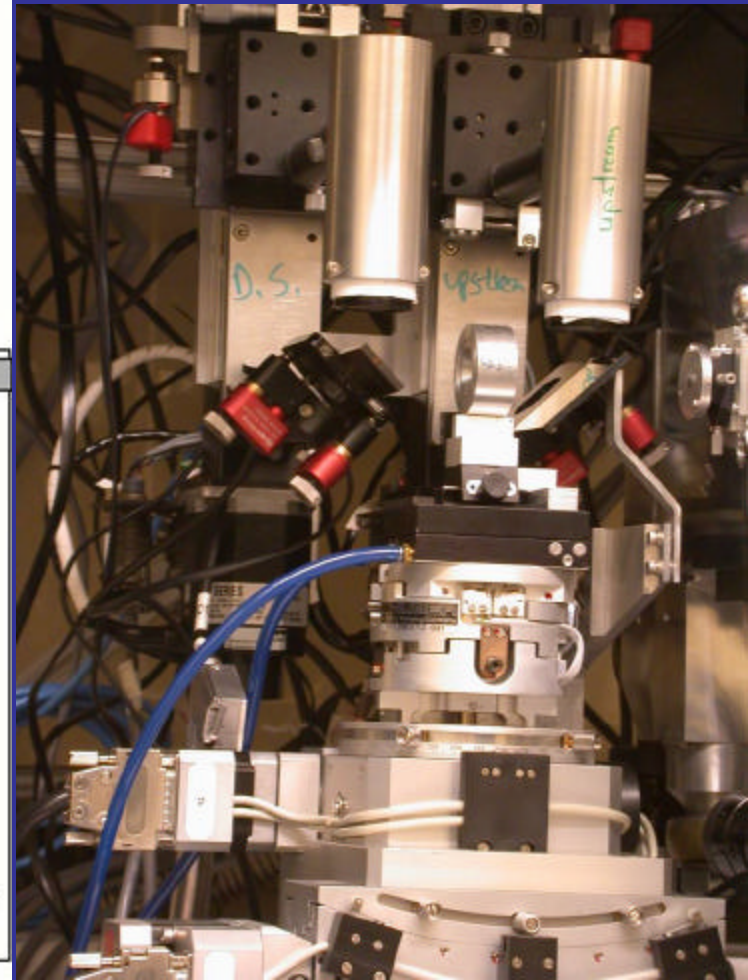


Lower Shelf Components

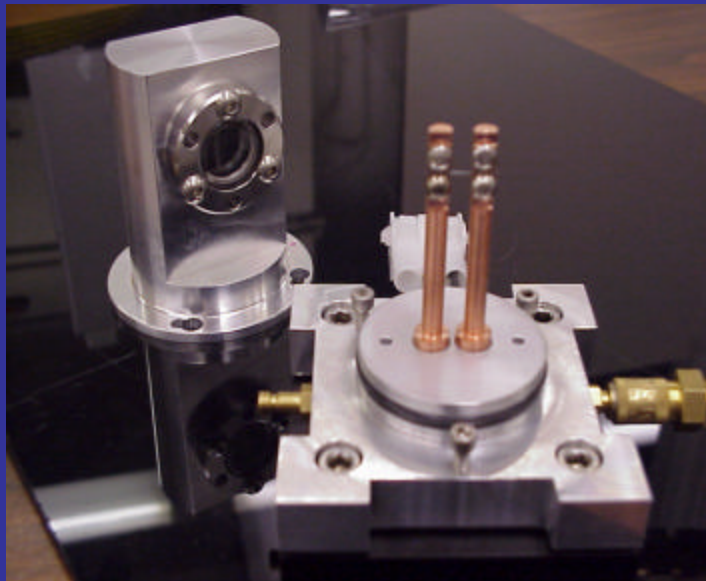
ALS LHDAC System - Lower Shelf



New --RailsNow Motorized!



Advanced Light Bulb

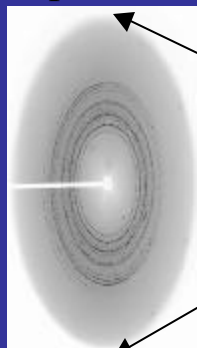


Apparatus designed and constructed to verify accuracy and precision of temperature analysis by the spectroradiometric setup at beamline 12.2.2. Melting points of pure metals were used as 'knowns' and these metals were melted in the device with the temperature hardware on fast collection speed.

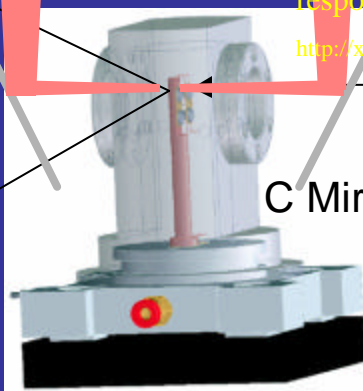
- The wire melter/heater is a useful method of validating the accuracy and precision of temperature determination by the spectroradiometric method.
- The best determination of temperature was obtained by fitting data in a wavelength range of 600-800 nm.
- The wire heater may be used as a secondary source for calibration of system response, once it is properly calibrated.

http://xrayweb.lbl.gov/bl1222/EXPERIMENTAL_FACILITIES/EXPERIMENTAL_FACILITIES.htm

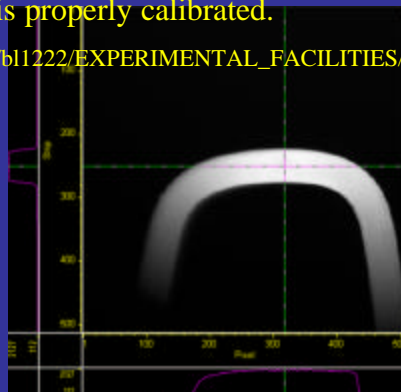
X-ray diffraction pattern



R laser (25 μm)

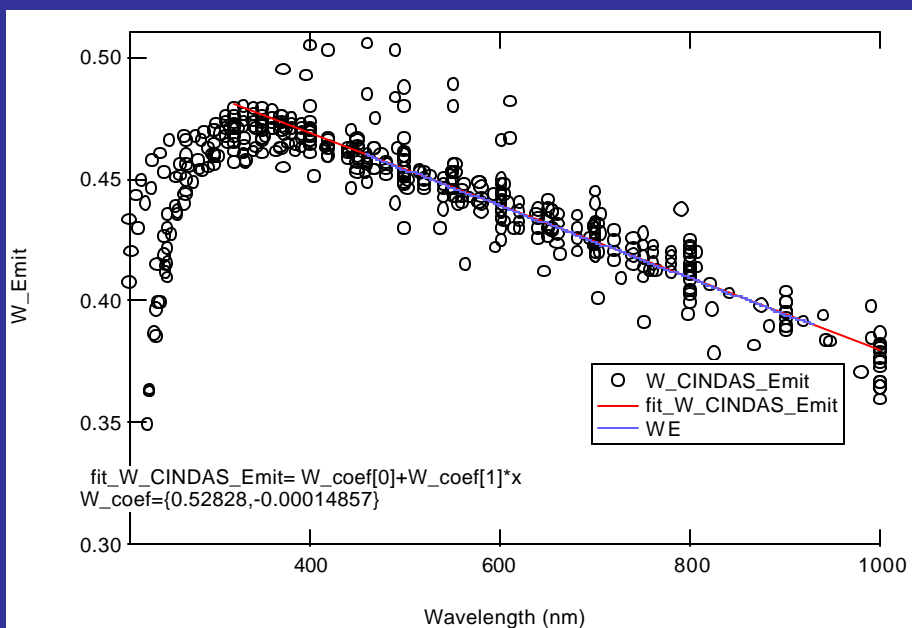
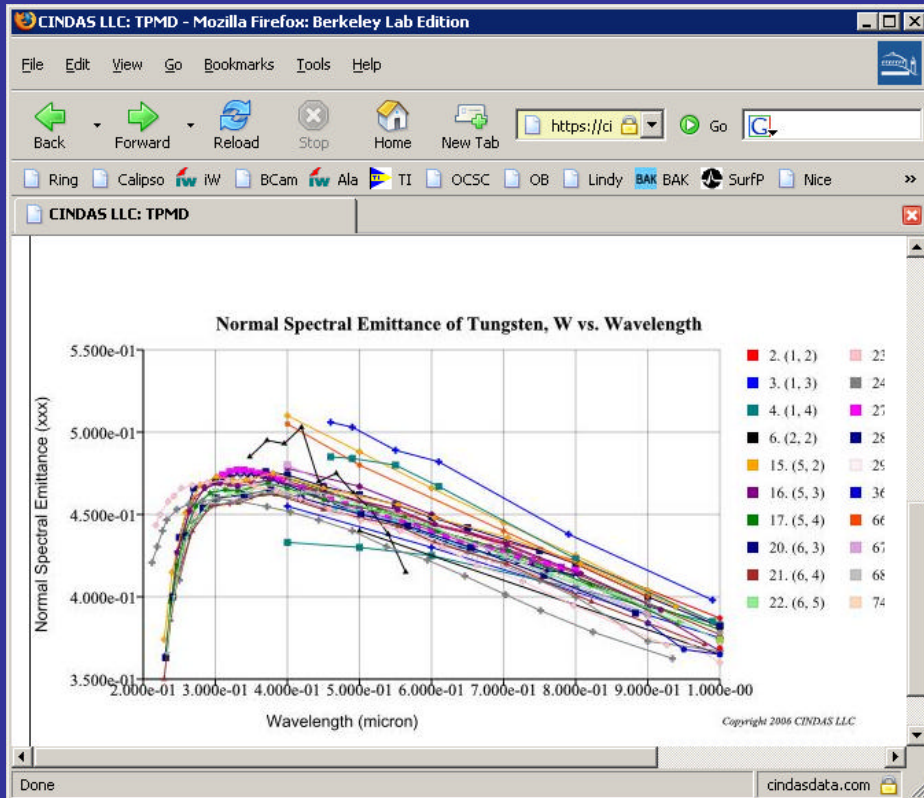


C Mirrors

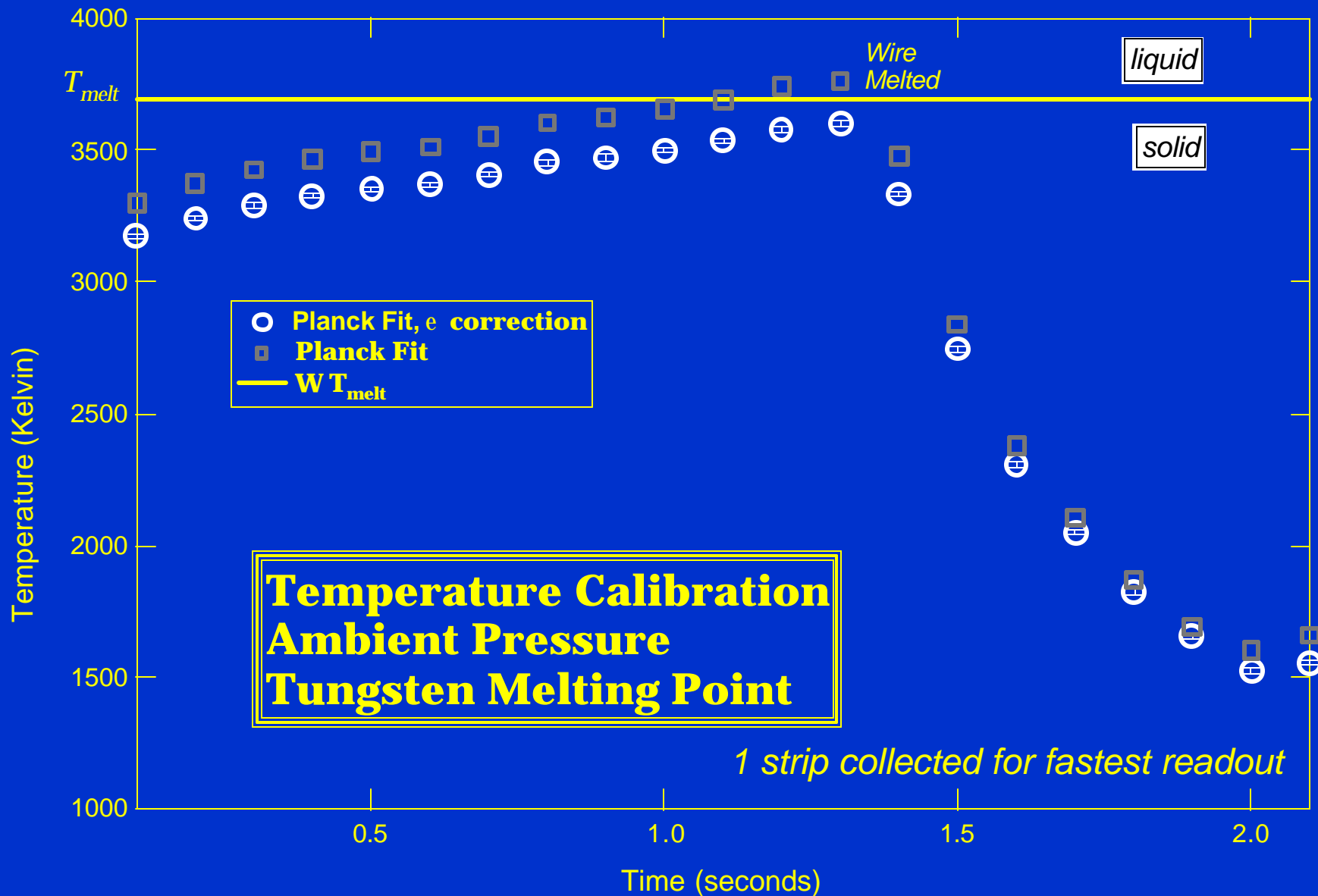


* The wire heater may be used in an inert gas atmosphere or in vacuum.

* The wire heater fits on the same stage as the DAC in the double-sided LHDAC experiment.



Temperature Calibration

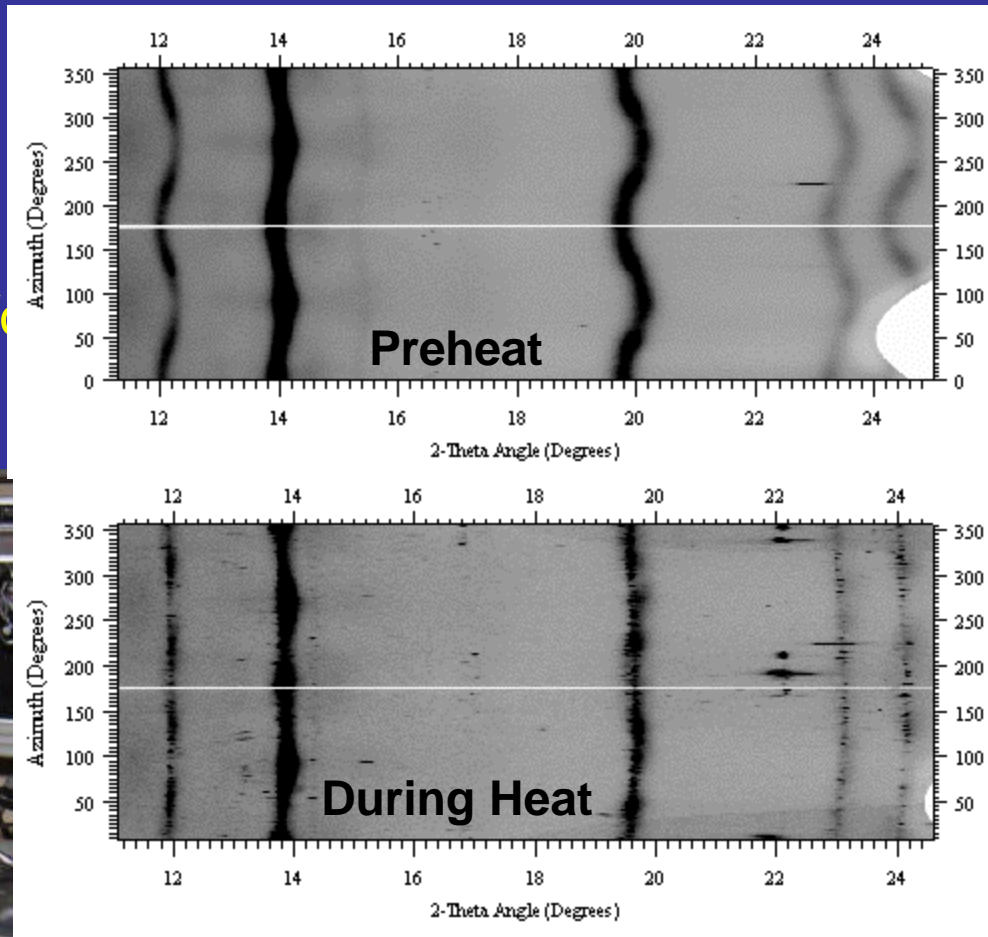
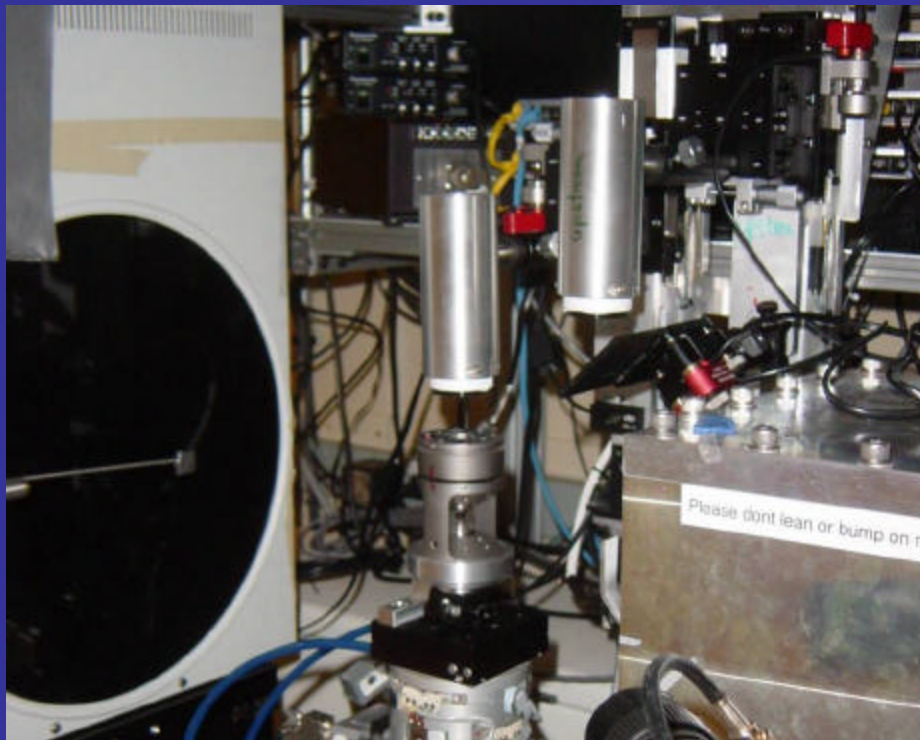


Temperature Calibration

- Image collection time 4 msec, readout time ~ 1 sec
- CCD single strip collection time 4 msec, readout time ~ 100 msec
- Emittance data from CINDAS website, linear fit

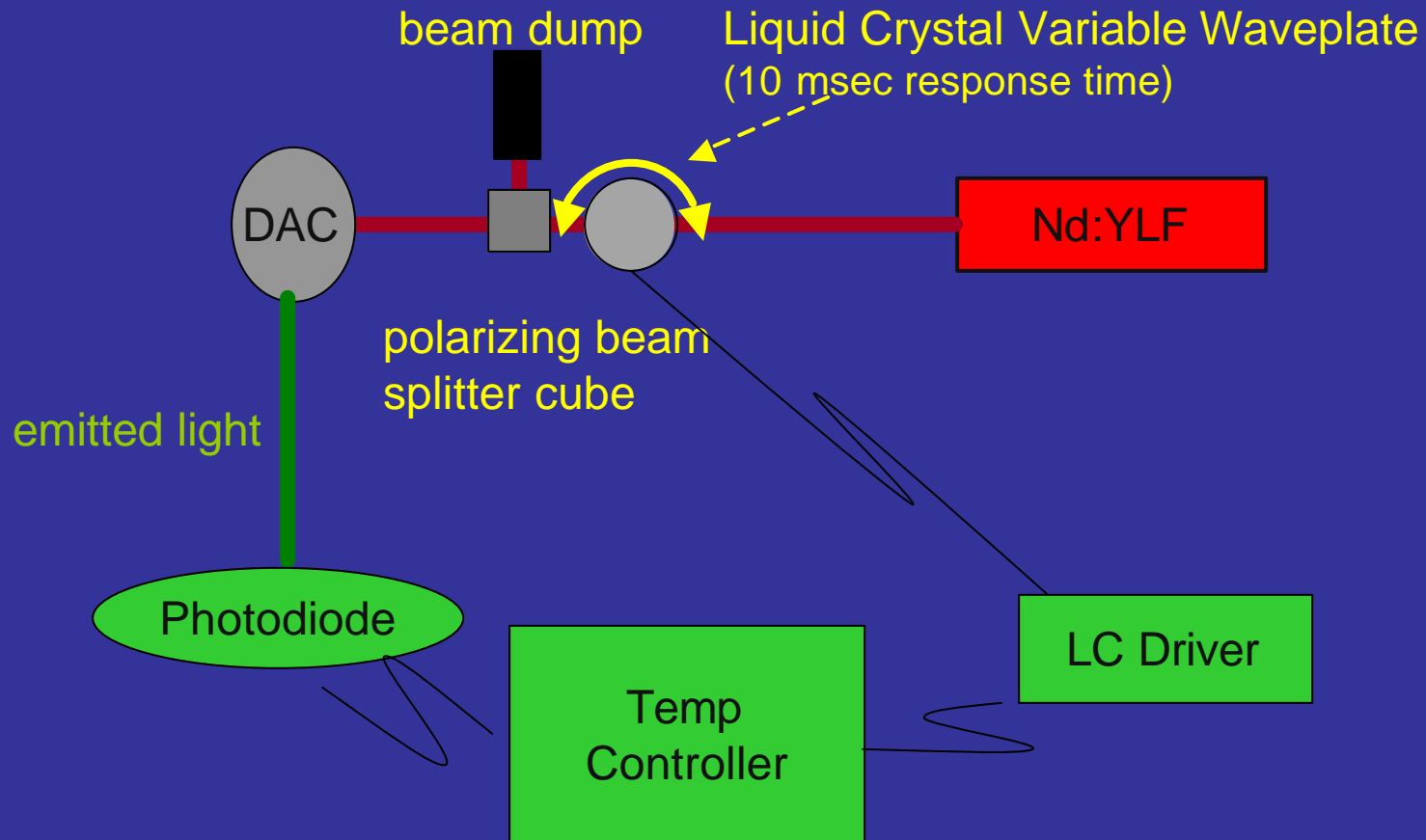
Laser Heating with Radial Diffraction

- MgO with Pt reference sphere, B epoxy gasket, ~30 GPa
- Simple rearrangement of beamline optics...realignment challenging w/ use of C mirror



- *XRD before, during and after heating shows xtal growth and relaxation of lattice strain and gradient
- *Miyagi & Wenk UCB EPS

Temperature Stabilization



Sketch of the temp control loop and hardware

Subcontracted to Michael Walter



Summary

- Laser system works well for double-sided annealing and heating of samples
- Temperature analysis is accurate for large objects
- Temperature analysis of gradients needs work
- Focusing of laser spot needs work
- Reliability of laser needs work